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ABSCESS IN GOAT AND SHEEP SKINS AND ITS EFFECT ON LEATHER QUALITY

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Leather making potentiality of Indian goat and sheep skins is conciderably affected due to the formation of abscesses in them. Abscesses could damage either the grain or the flesh side of the leather or even hydrolyse skin proteins leading to a perforation. Healedup abscesses resulted in scar formation. *Staph. aureus* was found to be mainly responsible for abscesses followed by *Staph. albus*. Certain physico-chemical changes in skin was indicated by increased alkaline swelling but the hydrothermal stability of the collagen fibres was not affected much. SATRA grain crack and bursting strength values of chrome tanned goat and sheep skins were found to be reduced to a certain extent. Area of leather damaged by abscesses appeared to be about 18% more than determined in the raw stage.

Suppurating lesions in the nature of abscess are of frequent occurrence in domestic animals. Abscess formation, especially in the hair follicle, is a feature of pyogenic infection. According to its size and location specific terms are often given to it, such as pustule, folliculitis, acne, boil/furuncle and carbuncle. The damage caused to the animal skin in and around the abscess lesion is obvious. The condition is further aggravated when the animals scratch or rub the affected areas against a rough surface due to irritation. In course of time these lesions naturally heal up by way of granulation tissue formation with resultant scar formation on the skin surface. Ripe lesions are, however, responsible for a greater damage than the healed up lesions.

A survey conducted at Perambur slaughter house, Madras revealed[1] that 5.05 per cent of goat and 3.42 per cent of sheep skins were affected in quality due to abscesses. Tancous et al[2] reported that folliculitis due to staphylococcous and streptococcous has little effect on the quality of leather. Considerable studies[3] have been made on abscesses in man and the organisms responsible for such abscesses but the information available on the abscesses in animals like goat and sheep and the causative organisms are very much limited. In view of the economic importance of the problem, the present study was undertaken with a view to throw more light on the types of organism responsible for abscess formation and the extent of damage caused by the abscesses to the quality of leather produced.

Materials and methods

For the purpose of investigation, 15 sheep and 14 goat skins affected with abscesses

were collected at Perambur slaughter house, Madras. On many occasions the abscesses got opened up in the slaughter house during flaying but for the present study, skins containing intact abscesses were collected.

Isolation and identification of the organisms from abscesses

The direct smears from the abscesses were taken, stained by Gram's technique and studied under the microscope. Cultures were carried out simultaneously by inoculating the pus material into the following media (a) blood agar (incubated both aerobically and anaerobically) and (b) MacConkey's agar (incubated aerobically). Appropriate selective media were also inoculated as and when required depending upon the findings of smear examination. All the cultured media were incubated at 37°C and examined after 24 and 48 hr. The organisms thus grown were identified on the basis of their morphology, cultural characteristics and biochemical reactions according to the standard methods.[4]

Histological technique

Skin pieces (1 sq. cm) were cut out from abscess lesions, embedded in paraffin and then sections (5μ) were cut. These skin sections were then stained by Haematoxylin and Eosin method[5], mounted on DPX and examined under microscope.

Alkaline swelling of skin

Affected areas around the abscesses of a sheep and a goat skin were cut out, weighed and treated with 10% solution of calcium hydroxide in a stoppered bottle for a period of 96 hrs. handling twice a day. The skin samples were weighed every 24 hr. after blotting off the surface moisture. After 96 hr. they were washed well to remove lime and then dried at 100°C till constant weight. Unaffected skin pieces from adjacent areas were also taken and the water uptake was determined as before. This was considered as control. The extent of water uptake was determined from the increase in skin weight and the results obtained are expressed as per cent swelling calculated on moisture free basis.

Microshrinkage of raw collagen fibres

Raw collagen fibres were teased out from the affected areas very close to the abscesses and the shrinkage temperature values were recorded with the help of a microshrinkage meter. Control fibres were taken out from the unaffected areas and the shrinkage temperature was determined as before. T_s values are expressed as °C.

Tanning procedure

The skins were tanned and finished into chrome and vegetable tanned leathers according to conventional methods.

Mean breaking length and elongation of vegetable tanned fibres

Vegetable tanned collagen fibres were taken from affected and unaffected areas for the determination of MBL and elongation. MBL was determined by using Instron Universal tensile strength testing machine, at a RH of 65 ± 2% and at a temperature of 25°C. The chart speed of 20 cm/min. and X head speed of 0.5 cm/min. were maintained during the test. The length of the specimen used was 1.0 cm. MBL was calculated according to the following equation and expressed in Kms.

$$\text{MBL} = \frac{\text{Breaking load (kg) x length of fibre (mm)}}{\text{Weight of the fibre } (\mu\text{g})}$$

Elongation was determined simultaneously and was expressed as per cent.

Results

Location of the abscesses in goat and sheep skins and the organisms associated with them

The location of the abscess in a skin and the number of abscesses per skin were noted and the organism or organisms associated with each of them were isolated and characterised. Observations are recorded in Table 1.

In goat skins abscesses are found to be located mostly in the belly and neck areas and in sheep skins in the neck and the back regions. Multiple abscesses are noted in 3 goat and 3 sheep skins. 34 organisms were isolated from 38 abscesses present in 29 skins (14 goat and 15 sheep skins). *Staph. aureus* was associated with 22 abscesses (57.9%) followed by *Staph. albus* with 9 abscesses (23.7%) and *Ps. aeruginosa* with 7 abscesses (18.4%). The

TABLE 1

Location of abscess in goat and sheep skins and the organisms associated with the abscesses

Goat			*Sheep*		
No.	*Location of the abscess*	*Organisms*	*No.*	*Location of the abscess*	*Organisms*
1.	Neck	*Staph.albus*	1.	Neck	*Staph. aureus*
2.	a) Belly	*Staph. aureus*	2.	a) Neck	,,
	b) Belly	,,		b) Neck	,,
	c) Belly	,,		c) Belly	,,
3.	a) Belly	,,	3.	Back	*Staph, aureus and Ps. aeruginosa*
	b) Belly	,,	4.	Back	,,
4.	a) Neck	*Staph. aureus and Ps. aeruginosa*	5.	Back	*Staph. albus and Ps. aeruginosa*
	b) Belly	,,	6.	Back	*Staph. aureus*
5.	Neck	*Staph. aureus*	7.	Back	*Staph. aureus and Ps. aeruginosa*
6.	Belly	*Staph. aureus and Ps. aeruginoso*	8.	Back	*Staph. aureus*
7.	Belly	*Diphtheroid*	9.	Belly	*Str. pyogenes*
8.	Belly	,,	10.	a) Neck	,,
9.	Back	*Staph. albus*		b) Back	,,
10.	Belly	*Staph. aureus*	11.	Neck	*Staph. aureus*
11.	Neck	,,	12.	a) Neck	,,
12.	Neck	*Diphtheroid*		b) Neck	,,
13.	Neck	*Staph. aureus*		c) Neck	,,
14.	Neck	,,	13.	Neck	,,
			14.	Shank	*Ps. aeruginosa*
			15.	Shank	*Staph. albus*

above three organisms were found to be associated with both the goat and sheep abscesses but *Ps. aeruginosa* in most occasions is present in association with *Staph.aureus*. Diphtheroid organisms are isolated from some abscesses in goat skin and *Streptococcus pyogenes* from sheep skins.

Histological characteristics of abscess affected areas of skins

Abscess affected areas from both goat and sheep skins were studied histologically and the following observations were recorded.

Folliculitis

Keratin and sebaceous materials were found to be accumulated in the hair follicles. It was accompanied by varying degree of follicular and perifollicular inflammation (Fig. 1)

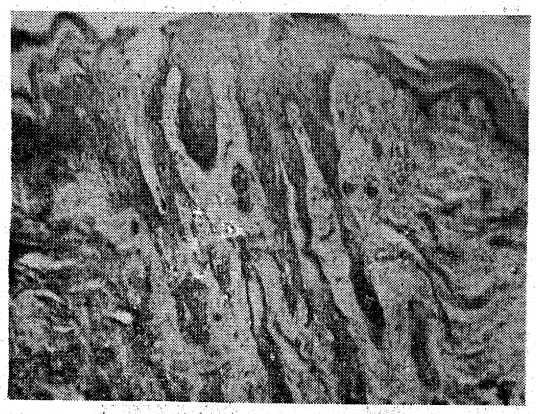

Fig. 1 : Section through the *folliculitis* in goat skin showing follicular and perifollicular inflammation and cellular infiltration. (H & E) x 50

Acne

Excessive accumulation of keratin and sebaceous materials occurred in the hair follicles. This formed the comedo. As a result of comedones there was slight atrophy of follicular epithelium and follicular and perifollicular inflammation (Fig. 2) which usually consisted of lympholytic infiltration. Foreign body gaint cells were present when follicles ruptured. Suppurative inflammation resulted in the formation of pustle in and around the follicle.

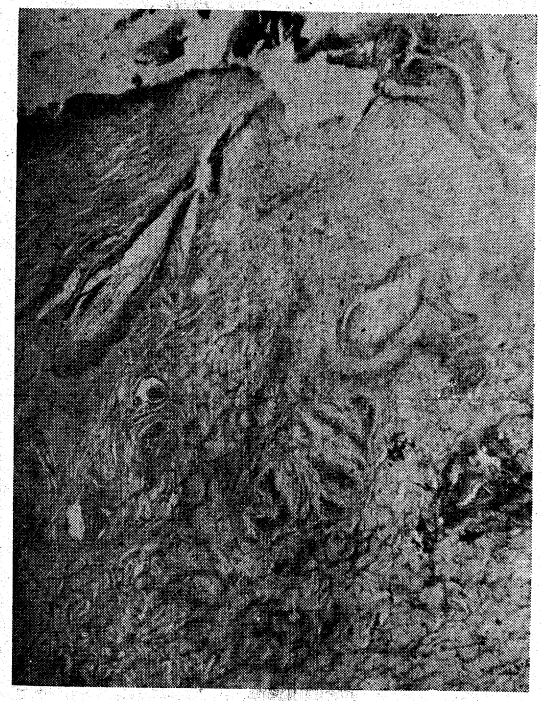

Fig. 2 : Section through the *acne* of goat skin showing an early comedo in a hair follicle, follicular and perifollicular inflammation. (H & E) x 30

Boil

The core of the ripe boil showed necrotic corium tissue infiltrated with leucocytes. The leucocytes were present in great numbers at the periphery where the tissue underwent liquefaction so that necrotic centre was discharged.

Carbuncle

The striking microscopic feature was the leucocytic infiltration of subcutaneous tissue,

the infiltration being particularly heavy in certain areas where extensive inflammatory oedema was formed.

Water uptake during alkaline treatment of skins

Water uptake during alkaline swelling was determined for both the abscess affected and unaffected areas of goat and sheep skins. The results obtained are presented in Table 2. It is evident from the results obtained that water uptake by the abscess affected areas of both goat and sheep skins during alkaline swelling is significantly higher than from normal area of skin.

TABLE 2

Water uptake during alkaline swelling of abscess-affected and unaffected areas of skin

Type of skin	*Period of alkaline treatment (hr)*	*Water uptake (%) on moisture free basis*	
		Control	*Abscess-affected*
Goat skin	24	310 . 00	748 . 00
	48	357 . 75	758 . 25
	72	369 . 50	771 . 25
	96	312 . 50	750 . 00
Sheep skin	24	644 . 50	827 . 00
	48	663 . 25	860 . 00
	72	691 . 00	859 . 25
	96	650 . 75	831 . 75

Hydrothermal stability of raw collagen fibres in abscess affected areas

Average T_s values of raw collagen fibres obtained from abscess affected areas of goat and sheep skins were determined. T_s was also determined for similar number of collagen fibres from the unaffected area of the same skin and the observations are recorded in Table 3.

The hydrothermal stability of collagen fibres from unaffected areas appears to be about 2°C higher in both goat and sheep skins than from the corresponding abscess affected areas.

Observations on the abscess lesions during processing of raw skin

The lesions caused by the abscesses were distinctly visible on the flesh side due to the bulging out of the skin surface (Fig. 3) but they were less prominent on the hair side as they were to some extent covered up by the hair or wool. (Fig. 4). The contents of the abscess were finely granular in some cases and soft, creamy in others. In few cases, the abscesses opened up either on the grain or on the flesh side. The floor of the abscess on the flesh side showed thick fibrous tissue which was adherent to the underlying subcutaneous tissues.

Fig. 3 : Abscess on the flesh side of goat skin

Limed pelt

The abscess affected area was thickened and became plumpy which was clearly felt on

TABLE 3

Influence of abscess formation in raw skin on the T_s of collagen fibres

Type of skin	*No. of skins*	*No. of fibres*	*T_s (°C)*					
			Abscess affected			*Control*		
			Min.	*Max.*	*Average*	*Min.*	*Max.*	*Average*
Goat skin	1	5	59	61	60	60	62	62
	2	6	58	60	59	59	62	61
	3	3	58	60	59	59	60	60
	4	3	59	60	59	62	64	63
	5	8	58	60	59	60	62	61
Average*				59				60
Sheep skin	1	3	55	57	56	61	63	62
	2	3	58	62	60	61	63	62
	3	8	58	60	59	62	65	64
	4	6	59	60	60	59	62	61
	5	5	59	63	62	59	64	63
Average*					59			61

*Average of twenty five individual fibres.

both grain and flesh sides. During unhairing and further wet processing, a depression either on the grain or on the flesh side appeared in the lesion because of the removal of the contents of the abscess.

Chrome crust and vegetable tanned leather

The abscess affected area was clearly demarcated from the normal skin area and was somewhat hard to feel. In most cases the grain was found to be damaged and appeared rough on handling (Fig. 5). On the flesh side, the lesion-affected area was also damaged. In some cases, perforation either on the grain or flesh side was noted (Fig. 6). In case of healed abscesses, the affected area appeared as a small scar on the grain side and as a whitish patch on the corresponding flesh side (Fig. 7)

Influence of abscess formation in skin on the mean breaking length and elongation of tanned fibres

Data on MBL and elongation are presented in Table 4. Data presented in the above indicate that the variation in MBL of vegetable tanned collagen fibres from abscess affected and unaffected areas is statistically not insignificant though the variation in per cent elongation appears to be significant at 5% level.

TABLE 4

MBL and elongation of vegetable tanned collagen fibres

	Abscess affected fibres		*Control fibres*
M. B. L. (Km)	3 . 12		3 . 66
Standard deviation	0 . 8		0 . 7
t value observed		1 . 5	
t value (theoretical) at 5% level		2 . 13	
Elongation (%)	15 . 69		22 . 65
Standard deviation	4 . 9		3 . 9
t value observed		3 . 3	
t value (theoretical) at 5% level		2 . 13	

Influence of abscess formation in skin on the SATRA grain crack and bursting strength values

Certain physical properties eg. SATRA grain crack and bursting strength of chrome tanned leathers are presented in Table 5.

It is apparent from Table 5 that in case of both goat and sheep skins SATRA grain crack and bursting strength values are comparatively low in abscess-affected areas than unaffected areas of leather.

Area of skin and leather affected by abscesses

The area of skin or leather affected by abscesses was measured in raw skins and tanned leathers and the values are expressed as sq.cm. Data obtained are presented in Table 6.

A thin strip of tanned and finished leather encircling the abscess-affected area was also found to be affected in quality which was apparent from the hardness and stiffness of the area and the difference in dye absorption compared to the unaffected area of leather. It may be noted from Table 6 that the total area affected by the abscess increases to different extent after tanning and finishing, the average increase in affected area being 18.0 per cent.

Discussion

The observations made in the present study (Table 1) indicate that organisms belonging to the genus staphylococci are mainly responsible for abscess formation in sheep and goat skins. Strains of *Staph.aureus* and *Staph. albus* were found to be associated with 80% of the abscesses. Strains of *Ps.aeruginosa* were, however, isolated from 18% of the abscesses, but in most occasions they were present in association with the staphylococcus strains.

It is known[6] that many localised pustular lesions of the skin are caused by staphylococci. The milder form, such as acne pustules, is usually associated with white staphylococci. The more severe forms such as boils or carbuncles are almost due to *Staph. aureus*. In animals,[7] staphylococci occur as commensals of the body surface. Organisms gain entrance through wounds and abrasions and cause superficial lesions such as boils, styies etc.

Besides staphylococci, pseudomonas and streptococci are also found to produce abscess[8] in sheep and goat skins. In domestic animals and man most clinical problems attributed to pseudomonas were associated with *Pseudomonas aeruginosa*.[9]

Accidental wounds are always found to be contaminated no matter how early they are seen after injury. The bacterial flora[6] of infected wound was found to differ both qualitatively and quantitatively and the organism

Fig. 4 : Abscess on the hair side of goat skin (hair clipped around the abscess)

Fig. 5 : Abscess on the grain side of sheep skin in chrome crust condition

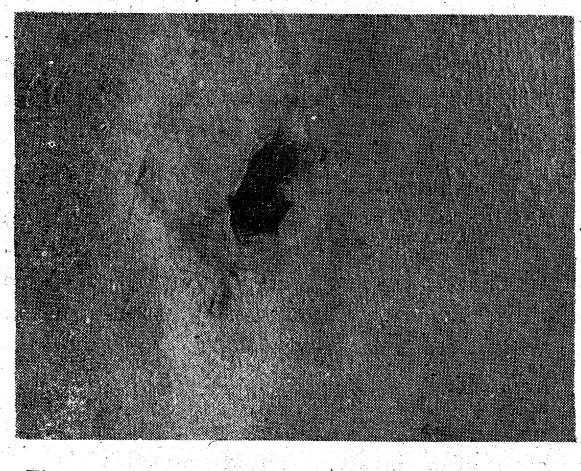

Fig. 6 : Abscess on the flesh side of sheep skin in chrome crust condition

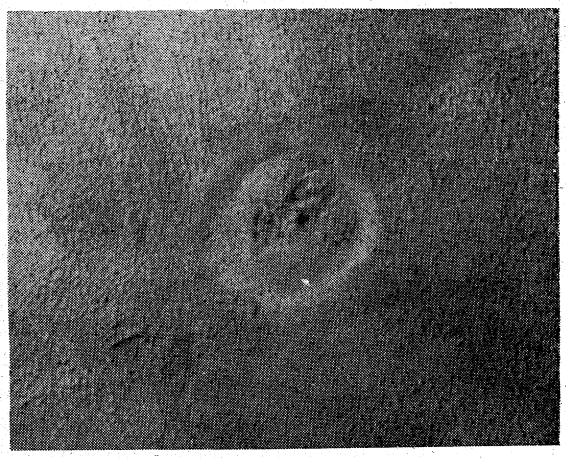

Fig. 7 : Healed abscess on the flesh side of vegetable tanned sheep skin

SATRA grain crack values of chrome crust leathers produced from abscess affected goat and sheep skins

Sample No.	Unaffected area				Affected area				Grain crack resistance (kg/cm thickness)		Bursting resistance (kg/cm thickness)	
	Grain crack		Bursting strength		Grain crack		Bursting strength					
	Dis. (mm)	Load (kg)	Dis. (mm)	Load (kg)	Dis. (mm)	Load (kg)	Dis. (mm)	Load (kg)	Unaffected area	Affected area	Unaffected area	Affected area
					Goat skin							
1.	8.14	14	11.22	36	8.20	12	8.26	14	140.0	120.0	360.0	140.0
2.	7.83	20	10.35	40	8.86	19	8.96	22	200.0	190.0	444.0	220.0
3.	8.35	10	12.89	24	7.76	10	9.34	14	100.0	100.0	240.0	140.0
4.	7.48	16	12.26	40	8.62	15	8.74	20	160.0	150.0	400.0	200.0
Average	7.95	15	11.69	35	8.36	14	8.82	17.5	150.0	140.0	350.0	175.0
					Sheep skin							
1.	8.95	12	10.80	18	6.95	10	7.85	12	133.3	190.9	200.0	109.0
2.	8.94	12	14.18	48	8.20	10	8.28	14	120.0	125.0	480.0	175.0
3.	9.37	20	10.14	24	7.64	14	8.25	20	222.2	175.0	266.6	250.0
4.	7.29	10	14.10	40	6.11	6	6.45	10	125.0	60.0	500.0	100.0
Average	8.63	13.5	12.30	32.5	7.22	10.0	7.70	14.0	150.1	112.7	361.6	158.5

6.0 mm & below = Sub standard
7.0 mm & below = Satisfactory
8.0 mm & above = Very good.